Test Equipment Depot
1-800-517-8431
99 Washington Street
Melrose, MA 02176
Phone 781-665-1400
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Arbitrary/Function Generator

AFG2021 Datasheet

- Built-in Modulation, Noise Generator, Burst, and Sweep modes for greater versatility
- Built-in waveforms provide quick access to commonly used signals
- Large 3.5 inch color screen displays both graphical and numeric waveform information simultaneously
- Menu and online help in 8 languages
- 2U height and half-rack width fits both benchtop and rack-mounted applications
- Free ArbExpress software makes waveform editing and downloading extremely easy
- Free SignalExpress software combines Tektronix bench instruments into a low-cost solution for automatic testing

Features & Benefits

- 20 MHz sine, 10 MHz square and pulse waveforms provide coverage for your most common applications
- 250 MS/s sampling rate and 14-bit vertical resolution enable the creation of high-fidelity signals
- The innovative UI reduces setup and evaluation time with direct access to frequently used functions and parameters
- The internal 4 × 128 kS memory and the USB memory expansion capability provide substantial capacity for defining complex waveforms
- USB remote control port and USB flash drive port are included. GPIB and LAN interfaces are available as an option

Applications

- Electronic test and design
- Sensor simulation
- Education and training
- Functional test
- System integration

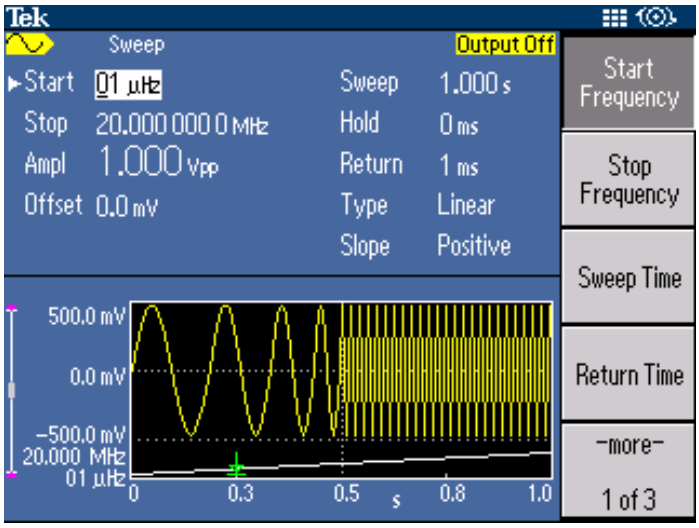
Tektronix

Superior Performance at an Affordable Price

Most electronic devices, circuits, and systems are designed to handle some form of signal. These signals can be simple like an audio frequency or clock signal or more complex like a serial data stream or the output of an airbag sensor during a crash. With 20 MHz bandwidth, 14-bit resolution, and 250 MS/s sample rate, the AFG2021 Arbitrary Function Generator can create both simple and complex signals at an entry-level price. With 12 standard waveforms, modulation capability, and a built-in noise generator you can quickly create the signal you need to thoroughly exercise your designs.

Intuitive User Interface

The innovative ease-of-use features first seen on the AFG3000 Series arbitrary/function generators are the building blocks for the AFG2021, providing quick access to setup and operational features. Experienced AFG3000 users will find it especially easy to set up the new AFG2021. A 3.5 inch color TFT screen shows relevant parameters in both graphic and text formats, so you can have full confidence in your settings and focus on the task at hand. The front-panel shortcut buttons and rotary knob provide quick access to the most frequently used functions and settings.



Frequency range from 1 µHz to 20 MHz, supports a wide range of amplifier and filter testing applications.

Excellent Frequency Agility

Traditional function generators created their output signals using analog oscillators and signal conditioning. The Tektronix AFG2021 relies on Direct Digital Synthesis (DDS) techniques. DDS technology synthesizes waveforms by using a single clock frequency to generate any frequency within the instrument's range. DDS architecture provides exceptional frequency agility, making it possible to program fast frequency and phase changes, which is useful for testing radio and satellite system components, amplifiers, and filters.

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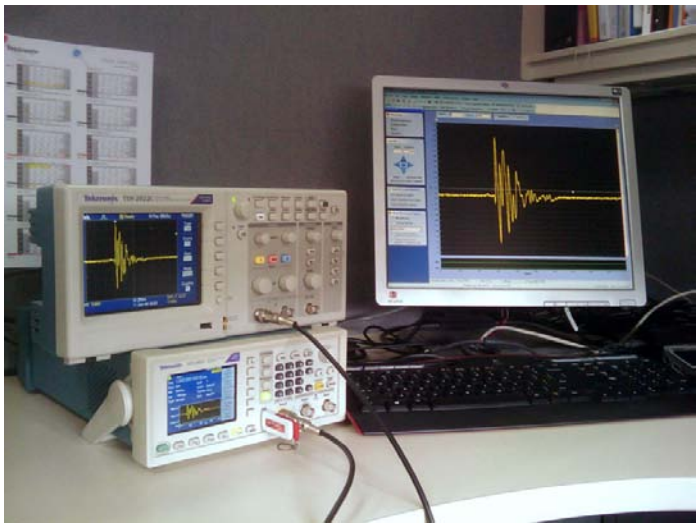

ArbExpress software helps you easily duplicate real-world signals.

ArbExpress® for Real-world Waveforms with Minimal Effort

With ArbExpress software, you can quickly create waveforms that can be transferred to the AFG2021 to meet custom stimulus requirements. ArbExpress supports direct connection to Tektronix oscilloscopes and AFGs through USB, GPIB, or LAN. The software allows you to import real-world signals captured with an oscilloscope onto a PC, then edit and download them onto an AFG to duplicate the captured waveform. This is extremely useful for automotive, medical, and industrial applications where recreating sensor output is critical to analyzing the integrity of the design.

Increase Productivity with SignalExpress

Every AFG2021 ships with a free copy of the Tektronix Edition of National Instrument's LabVIEW SignalExpress software for basic instrument control, data logging, and analysis. SignalExpress supports the range of Tektronix bench instruments enabling you to connect your entire test bench. You can then access each instrument from one intuitive software interface. This allows you to automate complex measurements requiring multiple instruments, log data for an extended period of time, time-correlate data from multiple instruments, and easily capture and analyze your results, all from your PC. Only Tektronix offers a connected test bench of intelligent instruments to simplify and speed debug of your complex design.

Connectivity

Using the front-panel USB host port, you can save your customized waveforms or instrument settings onto a USB memory stick. Reloading the data is easily done by plugging the device back into the USB host port. The USB device port and optional GPIB/LAN ports provide multiple alternatives for connecting the AFG2021 to your PC for waveform download and remote control.

Compact Form Factor

The 2U height and half-rack width form factor allow the AFG2021 to be stacked on other bench instruments, such as digital multimeters, power supplies, and frequency counters, saving valuable bench space. With the optional RMU2U rackmount kit, GPIB interface, and full SCPI support the AFG2021 is a perfect solution for automated test systems.

Characteristics

General

Characteristic	Description
Channels	1
Waveforms	Sine, Square, Pulse, Ramp, Noise, DC, Sin(x)/x, Gaussian, Lorentz, Exponential Rise, Exponential Decay, and Haversine
Sine Wave	1 µHz to 20 MHz
Sine Wave in Burst Mode	1 µHz to 10 MHz
Effective Maximum Frequency Out	20 MHz
Amplitude Flatness (1 V_{p-p})	
<5 MHz	±0.15 dB
5 MHz to 20 MHz	±0.3 dB
Harmonic Distortion (1 V_{p-p})	
10 Hz to 20 kHz	<–70 dBc
20 kHz to 1 MHz	<–60 dBc
1 MHz to 10 MHz	<–50 dBc
10 MHz to 20 MHz	<–40 dBc
THD	<0.2% (10 Hz to 20 kHz, 1 V_{p-p})
Spurious (1 V_{p-p})	
10 Hz to 1 MHz	<–60 dBc
1 MHz to 20 MHz	<–50 dBc
Phase Noise, Typical	20 MHz: <–110 dBc/Hz at 10 kHz offset, 1 V_{p-p}
Residual Clock Noise	–63 dBm
Square Wave	1 µHz to 10 MHz
Rise/Fall Time	≤18 ns
Jitter (RMS), Typical	<500 ps
Ramp Wave	1 µHz to 200 kHz
Linearity	≤0.1% of peak output at 10% to 90% of amplitude range
Symmetry	0.0% to 100.0%
Pulse Wave	1 mHz to 10 MHz
Pulse Width	30.00 ns to 999.99 s
Resolution	10 ps or 5 digits
Pulse Duty	0.001% to 99.999% (Limitations of pulse duty width apply)
Edge Transition Time	18 ns to 0.625 × Pulse Period
Resolution	10 ps or 4 digits
Lead Delay	
Range	Continuous Mode: 0 ps to Period Trigger/Gate Burst Mode: 0 ps to Period – [Pulse Width + 0.8 × (Leading Edge Time + Trailing Edge Time)]
Resolution	10 ps or 8 digits
Overshoot, Typical	<5%
Jitter (RMS), Typical	<500 ps
Other Waveforms	1 µHz to 200 kHz
Noise Bandwidth (–3 dB)	20 MHz
Noise Type	White Gaussian
DC (into 50 Ω)	–5 V to +5 V
Arbitrary Waveforms	1 mHz to 10 MHz
Arbitrary Waveforms in Burst Mode	1 mHz to 5 MHz
Effective Analog Bandwidth (–3 dB)	34 MHz
Nonvolatile Memory	4 waveforms
Memory: Sample Rate	2 to 128k: 250 MS/s
Vertical Resolution	14 bits
Rise/Fall Time	≤20 ns
Jitter (RMS)	4 ns
Amplitude, 50 Ω Load	10 mV_{p-p} to 10 V_{p-p}
Amplitude, Open Circuit	20 mV_{p-p} to 20 V_{p-p}
Accuracy	±(1% of setting + 1 mV), (1 kHz sine waveform, 0 V offset, >10 mV_{p-p} amplitude)
Resolution	0.1 mV_{p-p}, 0.1 mV_{RMS}, 1 mV, 0.1 dBm, or 4 digits
Units	V_{p-p}, V_{RMS}, dBm (sine wave only)
Output Impedance	50 Ω
Load Impedance Setting	Selectable: 50 Ω, 1 Ω to 10.0 kΩ, High Z (adjusts displayed amplitude according to selected load impedance)
Isolation	<42 V_{Peak} maximum to earth
Short-circuit Protection	Signal outputs are robust against permanent shorts against floating ground
External Voltage Protection	To protect signal outputs against external voltages use fuse adapter 013-0345-00
DC Offset Range, 50 Ω Load	±(5 V_{Peak} – amplitude V_{p-p}/2)
DC Offset Range, Open Circuit	±(10 V_{Peak} – amplitude V_{p-p}/2)
Accuracy	±(1% of |setting| + 5 mV + 0.5% of amplitude (V_{p-p}))
Resolution	1 mV

Modulation

AM, FM, PM

Characteristic	Description
Carrier Waveforms	All, including ARB, except Pulse, Noise, and DC
Source	Internal/External
Internal Modulating Waveform	Sine, Square, Ramp, Noise, ARB (AM: Maximum waveform length 4,096; FM/PM: Maximum waveform length 2,048)
Internal Modulating Frequency	2 mHz to 50.00 kHz
AM Modulation Depth	0.0% to +120.0%
Min FM Peak Deviation	DC
Max FM Peak Deviation	10 MHz

Frequency Shift Keying

Characteristic	Description
Carrier Waveforms	All, including ARB, except Pulse, Noise, and DC
Source	Internal/External
Internal Modulating Frequency	2 mHz to 1.000 MHz
Number of Keys	2

Pulse Width Modulation

Characteristic	Description
Carrier Waveform	Pulse
Source	Internal/External
Internal Modulating Waveform	Sine, Square, Ramp, Noise, ARB (Maximum waveform length 2,048)
Internal Modulating Frequency	2 mHz to 50.00 kHz
Deviation	0% to 50.0% of pulse period

Sweep

Characteristic	Description
Waveforms	All, including ARB, except Pulse, Noise, and DC
Type	Linear, Logarithmic
Sweep Time	1 ms to 300 s
Hold/Return Time	0 ms to 300 s
Max Total Sweep Time (Sweep + Hold + Return)	300 s
Resolution	1 ms or 4 digits
Total Sweep Time Accuracy, Typical	0.4%
Min Start/Stop Frequency	All except ARB: 1 µHz ARB: 1 mHz
Max Start/Stop Frequency	Sine: 20 MHz Square: 10 MHz ARB: 10 MHz Others: 200 kHz

Burst

Characteristic	Description
Waveforms	All, including ARB, except Noise and DC
Type	Triggered, Gated (1 to 1,000,000 cycles or Infinite)
Internal Trigger Rate	1 µs to 500.0 s
Gate and Trigger Sources	Internal, External, Manual Trigger, and Remote Interface

Auxiliary Input

Modulation Input

Characteristic	Description
Input Range	All except FSK: ±1 V full scale FSK: 3.3 V logic level
Impedance	10 kΩ
Frequency Range	DC to 25 kHz (122 kS/s sample rate)

External Triggered/Gated Burst Input

Characteristic	Description
Level	TTL compatible
Pulse Width	100 ns minimum
Slope	Positive/Negative selectable
Trigger Delay	0.0 ns to 85.000 s
Resolution	100 ps or 5 digits
Jitter (RMS), Typical	Burst: <500 ps (Trigger input to signal output)

10 MHz Reference Input

Characteristic	Description
Impedance	1 kΩ, AC coupled
Required Input Voltage Swing	100 mV_{p-p} to 5 V_{p-p}
Lock Range	10 MHz ±35 kHz

Auxiliary Output

Trigger Output

Characteristic	Description
Level	Positive TTL level pulse into 1 kΩ
Impedance	50 Ω
Jitter (RMS), Typical	500 ps
Max Frequency	4.9 MHz (4.9 MHz to 20 MHz: A fraction of the frequency is output)

Common Characteristics

Remote Programming (GPIB, LAN 10BASE-T/100BASE-TX, USB 1.1, compatible with SCPI-1999.0 and IEEE 488-2 standards)

Characteristic	USB	LAN*1	GPIB*1
Function Change	95 ms	103 ms	84 ms
Frequency Change	2 ms	19 ms	2 ms
Amplitude Change	60 ms	67 ms	52 ms
Select User ARB	88 ms	120 ms	100 ms
Data Download Time for 4k Point ARB Waveform Data (8 KB), Typical	20 ms	84 ms	42 ms

*1 GPIB and LAN interfaces are only available on the instrument with Option GL.

General

Characteristic	Description
Frequency Setting Resolution	1 µHz or 12 digits
Phase (except DC, Noise, Pulse)	
Range	–360° to +360°
Resolution	Sine: 0.01° Other Waveforms: 0.1°
Internal Noise Add	When activated, output signal amplitude is reduced to 50%
Level	0.0% to 50% of amplitude (V_{p-p}) setting
Resolution	1%
Main Output	50 Ω
Effective Frequency Switching Speed	2 ms through remote control
Internal Frequency Reference	
Stability	All except ARB: ±1 ppm, 0 °C to 50 °C ARB: ±1 ppm, ±1 µHz, 0 °C to 50 °C
Aging	±1 ppm per year
Power Source	100 V to 240 V, 50 Hz to 60 Hz or 115 V, 400 Hz
Power Consumption	60 W
Warm-up Time, Typical	20 minutes
Power On Self Diagnostics, Typical	<10 s
Acoustic Noise, Typical	<50 dBA
Display	3.5 in. Color TFT LCD
User Interface and Help Language	English, French, German, Japanese, Korean, Simplified and Traditional Chinese, Russian (User selectable)

Physical Characteristics

Benchtop Configuration

Dimension	mm	in.
Height	104.2	4.10
Weight	241.8	9.52
Depth	419.1	16.50
Weight	**kg**	**lb.**
Net	2.87	6.3
Shipping	4.72	10.4

Environmental and Safety Characteristics

Characteristic	Description
Temperature	
Operating	0 °C to +50 °C
Nonoperating	–30 °C to +70 °C
Humidity	
Operating	≤80%, +0 °C to +40 °C, noncondensing ≤60%, +40 °C to +50 °C, noncondensing
Nonoperating	5% to 90%, <+40 °C, noncondensing 5% to 80%, ≥+40 °C to ≤+60 °C, noncondensing 5% to 40%, >+60 °C to ≤+70 °C, noncondensing
Altitude	
Operating	Up to 3,000 m (9,842 ft.)
Nonoperating	Up to 12,000 m (39,370 ft.)
EMC Compliance	EU Council Directive 2004/108/EC
Safety	UL61010-1; 2004 CAN/CSA C22.2 No. 61010-1; 2004 EN61010-1; 2001 IEC61010-1; 2001

Ordering Information

AFG2021

Arbitrary/Function Generator.
Includes: User Manual, Power Cord, USB Cable, CD-ROM with Programmer Manual, Service Manual, Labview and IVI Drivers, CD-ROM with ArbExpress® Software, NIST-traceable Calibration Certificate.

Please specify power cord and local language for user manual when ordering.

Configuration Options

Option	Description
Opt. GL	GPIB and LAN interfaces

Language Options

Option	Description
Opt. L0	English manual
Opt. L1	French manual
Opt. L2	Italian manual
Opt. L3	German manual
Opt. L4	Spanish manual
Opt. L5	Japanese manual
Opt. L6	Portuguese manual
Opt. L7	Simplified Chinese manual
Opt. L8	Traditional Chinese manual
Opt. L9	Korean manual
Opt. L10	Russian manual
Opt. L99	No manual

Power Plug Options

Option	Description
Opt. A0	North America power
Opt. A1	Universal Euro power
Opt. A2	United Kingdom power
Opt. A3	Australia power
Opt. A5	Switzerland power
Opt. A6	Japan power
Opt. A10	China power
Opt. A11	India power
Opt. A12	Brazil power
Opt. A99	No power cord or AC adapter

Service Options

Option	Description
Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R5	Repair Service 5 Years
Opt. R5DW	Repair Service Coverage 5 Years (starts at time of customer instrument purchase)

Recommended Accessories

Accessory	Description
RMU2U	Rackmount kit
013-0345-00	Fuse adapter, BNC-P to BNC-R
159-0454-00	Fuse set, 3 pcs, 0.125 A
012-0482-00	BNC cable shielded, 3 ft.
012-1256-00	BNC cable shielded, 9 ft.
012-0991-00	GPIB cable, double shielded
011-0049-02	50 Ω BNC terminator

Warranty

Three-year warranty on parts and labor.